

METHOD AND APPARATUS FOR CONTROLLING THRESHOLD VOLTAGE

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims priority from Korean Patent Application No. 10-2015-0108755, filed on Jul. 31, 2015 in the Korean Intellectual Property Office, the disclosure of which is incorporated herein by reference in its entirety.

BACKGROUND

[0002] 1. Field

[0003] Methods and apparatuses consistent with exemplary embodiments relate to a method and an apparatus for controlling a threshold voltage.

[0004] 2. Description of the Related Art

[0005] Recently, due to popularization of smartphones, an event-based vision sensor capable of operating with low calculation and low power consumption in comparison to a frame-based vision sensor is increasingly utilized. In the frame-based vision sensor, signals are output from all sensing elements every frame, whereas in the event-based vision sensor, a signal is output from a sensing element in which an intensity of light changes. Accordingly, in the event-based vision sensor, calculation and power consumption may be reduced.

[0006] However, the event-based vision sensor may use a threshold voltage to sense a change in an intensity of light and to output a signal. Due to a limitation in manufacturing of event-based vision sensors, ideal threshold voltages may be different from each other even though the same manufacturing process are used to manufacture event-based vision sensors.

[0007] When the same threshold voltage is applied to all a plurality of event-based vision sensors manufactured by the same manufacturing process, it may be difficult to correct an optimum performance of the event-based vision sensors. In addition, there is a limitation to a method of manually determining an ideal threshold voltage of an event-based vision sensor.

SUMMARY

[0008] Exemplary embodiments may address at least the above problems and/or disadvantages and other disadvantages not described above. Also, the exemplary embodiments are not required to overcome the disadvantages described above, and may not overcome any of the problems described above.

[0009] According to an aspect of an exemplary embodiment, there is provided a threshold voltage control method including receiving noise event signals from a sensing core, the sensing core sensing a portion of a moving object, and generating an event signal. The threshold voltage control method further includes determining a type of the noise event signals, determining a number of the noise event signals based on the type of the noise event signals, determining whether the number of the noise event signals satisfies a condition, and controlling a threshold voltage value corresponding to the noise event signals in response to the determining that the number of the noise event signals does not satisfy the condition.

[0010] The noise event signals may be output from the sensing core on which light having a constant intensity is incident.

[0011] The determining the type may include determining each of the noise event signals as either an ON event signal or an OFF event signal.

[0012] The determining the number of the noise event signals may include determining a number of ON event signals among the noise event signals, and determining a number of OFF event signals among the noise event signals.

[0013] The controlling may include increasing or decreasing the threshold voltage value by a value based on a type of a transistor included in the sensing core.

[0014] The condition may include at least one among an allowable number of noise event signals in a period of time, and a ratio between a number of ON event signals and a number of OFF event signals among the noise event signals.

[0015] The sensing core may generate the ON event signals in response to the sensing core determining that an amount of an increase in an intensity of light incident on the sensing core is greater than a first threshold variation, and the sensing core may generate the OFF event signals in response to the sensing core determining that an amount of a decrease in the intensity of the light incident on the sensing core is greater than a second threshold variation.

[0016] The threshold voltage control method may further include transmitting the threshold voltage value to a bias generator, the bias generator generating a threshold voltage based on the threshold voltage value, and providing the threshold voltage to the sensing core.

[0017] The sensing core may generate an event signal based on an operating point that is determined based on the threshold voltage value.

[0018] The receiving, the determining the type, the determining the number of the noise event signals, the determining whether the number of the noise event signals satisfies the condition, and the controlling may be repeatedly performed until the number of the noise event signals satisfies the condition.

[0019] The threshold voltage control method may further include storing the threshold voltage value in a bias generator in response to the determining that the number of the noise event signals satisfies the condition, the bias generator providing the threshold voltage to the sensing core.

[0020] The sensing core may be included in an event-based vision sensor generating an event signal in response to an event in which light that is received from the object asynchronously changes.

[0021] A non-transitory computer-readable storage medium may store a program for causing a processor to perform the method.

[0022] According to an aspect of another exemplary embodiment, there is provided a threshold voltage control apparatus including a communicator configured to receive noise event signals from a sensing core, the sensing core sensing a portion of a moving object and generating an event signal. The threshold voltage control apparatus further includes a controller configured to determine a type of the noise event signals, determine a number of the noise event signals based on the type of the noise event signals, determine whether the number of the noise event signals satisfies a condition, and control a threshold voltage value corresponding to the noise event signals in response to the